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East Europe Report

SCIENTIFIC AFFAIRS

(FOUO 6/81)

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CONTENTS

CZECHOSLOVAKIA

CSSR CRYOSURGICAL METHODS DISCUSSED

Prague CASOPIS LEKARU CESKYKH in Czech No 5, 5 Feb 81 pp 140-143

[Article: "Cryosurgery, the Application of Low Temperatures"; report on 13 October 1980 evening report session of the Association of Czech Physicians, Prague]

[Text] This evening meeting was coordinated by Jiri Riha, M D of the Surgical Department of OUMZ Benesov near Prague.

Members of the Research Institute of High Voltage Electrical Engineering [VUSE] in Prague-Bechovice, the Gynecological-Obstetrical Department of the Kraj Hospital and Polyclinic [KNSP] in Ostrava, the Gynecological-Obstetrical Clinic of the Medical Faculty of Hygiene Charles University [LFH KU] in Prague, the Surgical Clinic of the Faculty of Pediatrics, KU Prague-Motol, and the First Stomatological Clinic of the Faculty of General Medicine, KU took part in the evening program.

Baier, J.: The Current Status of the Development of Cryosurgical Instruments

Modern commercially available cryosurgical instruments for clinical use focus on two approaches. In the first, the operating tip of the probe is cooled by the expansion of compressed CO_2 or N_2O and reaches a minimum temperature of -78° or -88° C respectively. The other design utilizes the evaporation of liquid nitrogen in the operating tip, making it possible to achieve minimum temperatures as low as -196° C.

The expansion-cooled instruments are suitable for shallow lesions, have a lower cooling power and operate with a relatively high pressure inside the probe. However, they are simple in design and accordingly cheaper, and use a coolant generally available in hospitals. The nitrogen-cooled instruments are suitable for larger lesions, always have a higher power, are virtually pressureless and have general applicability. But they are more complex in design and more expensive, the coolant is not generally available in hospitals, and the length of time it can be stored is limited

Most instruments supplies today have the probe attached to the coolant source by a system of two or three concentric hoses. They have the advantage of a large coolant supply and a relatively light probe, but their maneuverability is limited by the hoses. This disadvantage can be eliminated by using self-contained nitrogen-cooled instruments in which the probe is fixed to a small Dewar flask which must be filled with liquid nitrogen from time to time. Some authors give preference, particularly in dermatology, to direct spraying of the pathological tissue with liquid nitrogen.

Currently the most reliable method of monitoring the growth of the frozen area and of protecting neighboring tissue from harm from the cold is to insert thermocouples contained in thin hypodermic needles into strategic locations in the tissue. An alternative method is to measure the low-frequencey bioelectrical impedance of the tissue.

Malek, Z.: The KCH-3A Czechoslovak Cryosurgical System, Intended Primarily for Malignant Tumor Surgery

This device is a prototype prepared for production which was developed by the VUSE in Prague-Bechovice in cooperation with the Institute of Physics, CSAV, in Rez near Prague. Its development was based on experience acquired in more than 600 operations conducted with the first two operating models, the KCH-1A and the KCH-1B, which were used to test the basic conception of the equipment under clinical conditions at 16 clinical organizations. A description of the experimental models is published in CESKOSLOVENKIY CASOPIS PRO FIZIKU, A30, no 5, 1980, pp 485-491.

Like the earlier models, the KCH-3Z system consists of a cryogenic section, which is the operating instrument itself, cooled by internal circulation of liquid nitrogen, and an electronic secion which both automatically assures optimum functioning of the instrument and gives the surgeon the information he needs for safe and reliable performance of the procedure.

The operating instrument again utilizes an original-design high-efficiency heat exchanger described by Malek, Pust and Ryska in CRYOGENICS, 17, 1977, p 543, but the temperature of the operating tip is now measured at its surface so that the physician performing the operation is kept informed of the temperature of the tissue with which it is in contact during cryodestruction and melting. The physician selects the operating temperature in digital form before (or during) the operation, and the device maintains this temperature automatically and indicates the instantaneous temperature in digital form.

The surgeon uses a toggle switch to select either the base temperature of the instrument (+36° C) or the set operating temperature (0° to -195° C). The maximum rate of cooling of the operating tip at a cooling power of 60 W is 13° C per second.

The instrument has a physiologically designed handle which contains a liquid nitrogen tank holding 0.3 liters. Its weight is 1,050 grams, the working pressure is 30 kPa (0.3 atm), the maximum permissible inclination of the instrument is ±60°, and the diameter of the operating tube is 12 mm! The system includes two interchangeable thermometers 0.6 mm in diameter, which are inserted into the tissue at selected points to monitor the temperature.. The readings are also displayed digitally.

Temperature values may be chosen for the thermometers before the operation; when these values are reached the fact is indicated by special sound signals. The surgeon thus can concentrate entirely on his operating procedure, and can obtain the necessary information on the course of cryolysis acoustically. In addition, the system gives a digital readout of either the duration of the operation or the time during which the temperature has been lower than -25° C.

Data on the surface temperature of the applicator and the temperatures in the two thermometers inserted into the tissue (e.g., at the intended boundary of cryolysis and in a location where the temperature of a nearby healthy organ must not fall below a safe value, say +15° C, can also be recorded with a multipen recorder, for which the device has the necessary outputs. The working pressure in the tank is automatically controlled, and the pressure in the tank and in the instrument are prevented from exceeding the selected maximum value by two mechanical safety switches. In practice, the full cooling power is used only during rapid cooling of the instrument; after the selected minimum temperature is reached, the power is automatically maintained at a value equal to the heat transfer from the tissue to the operating tip. The high maximum cooling power meets the requirements imposed on future third-generation cryosurgical systems by affording the possibility of using point operating tips and assuring the necrotizing effects of high cooling rates even inside tumors.

Three liquid nitrogen levels in the tank are indicated optically. The net operating time for one filling of the tank is between 15 and 30 minutes depending on the size of the lesion.

The prototype has been tested at four clinical organizations and recommended for production. Currently, tests of the long-term reliability of the system and discussions on organizing its production are under way.

Honek, L.: Advantages of Treating Lesions of the Cervic with the Liquid Nitrogen Cryocauter

Cryosurgery has been used in the Gynecological Department of KNsP in Ostrava since 1972. A Dynagyne DCG 8000 instrument is used. Low temperatures are obtained by expansion, using the Joule-Thompson effect.

In the last 8 years, 2,942 cryosurgical procedures have been conducted on the cervix. Optimal results have been obtained in 86.4 percent of benign lesions and 76.5 percent of suspect lesions. Results other than excellent were obtained primarily in cases of extensive lacerated ectropium, when the focus of the process could not be removed with the low cooling effect obtained with instruments cooled by nitrous oxide or carbon dioxide. These temperatures are suited in most cases only for surface lesions. For extensive and deeper foci, a system cooled with liquid nitrogen which can produce an operating temperature as low as -196° C must be used.

In 1979 clinical tests of a cryocauter developed by VUSE in Prague-Bechovice began.

In technical terms, this is a powerful cryosurgical device cooled by liquid nitrogen whose design uses the highly effective Malek heat exchanger. Cooling of the tip from 37° C to -196° C takes 4 to 6 seconds. The operating tip can be chosen as needed in accordance with anatomical measurements and the nature of the operation.

In 220 out of 230 cases, the cervix was treated by the vaginal route. The temperature of the cervix was measured by two tissue thermometers, most often at the center and the edge of the lesion. The cooling power of the device was set at the maximum, i.e., at -196° C. The duration of the procedure depended on the size of the lesion and the tissue thermometer readings. This made it possible to obtain the exact cooling power required. Postoperative procedures were similar to those used after treatment with the expansion-cooled device, and even though much lower temperatures were used there were no complications.

Of a group of 165 women treated for large lacerated extropium, optimal results (i.e., primary epithelium, iodine test positive, sharp boundary with cylindrical epithelium in the vicinity of the external os, or only a narrow zone of tiled

Of a group of 165 women treated for large lacerated extropium, optimal results (i.e., primary epithelium, iodine test positive, sharp boundary with cylindrical epithelium in the vicinity of the external os, or only a narrow zone of tiles metaplasia in the form of a single opening) were obtained with 158, i.e., 95.7 percent. This figure is 15.7 percent higher than for the control group of 1,246 cases of lacerated ectropium treated with the expansion-cooled device, in which optimal results were obtained for 997 cases. Epithelization was faster in the cases treated with the nitrogen-cooled device; in this group of 165 women, optimal results were obtained after 6 weeks in 144 cases, i.e., 87.2 percent, compared with 42.5 percent for the control group in the same period. In seven cases, the cervix healed with only slight residual signs. The results of treatment of suspect lesions will be discussed in subsequent communications.

In conclusion, the advantages of the device are:

1. A high percentage of clinically optimal healing of lesions in a shorter time period than with the expansion-cooled device.

2. A high cooling power with the possibility of maintaining any desired temperature down to -196° C.

3. High tip-cooling speed.

4. Low consumption of liquid nitrogen (400 cm^3 suffices for more than 30 minutes of operating time).

5. Precise measurement of the temperature of the frozen tissue and digital display of the readings.

6. Low working nitrogen pressure.

The device is simple to service and easy to operate, and gynecologists can master it after brief training. The prototype instrument tested is fully comparable with imported cryosurgical instruments and in many cases has better characteristics.

The elimination of slow metaplastic processes in the uterus, consistent oncological negativity in cytological preparations, and a clear and sharp boundary between the two epithelia, entirely located within the external os, make it possible to include cryotherapy among the methods of comprehensive protection of women from cancer of the cervical canal as defined by Kanka.

Kanka, J. Svoboda, B. and Havrankova, A.: Cervical Cryotherapy for Prevention of Carcinoma of the Cervical Canal

The main province of cryotherapy in gynecology is the cervical canal and its defects.

In connection with the prevention of carcinoma of the cervical canal we must distinguish cryotherapy of benign defects from cryotherapy of suspect lesions, whose basis is a precancerous condition. In the first case, the aim of treatment is to eliminate the benign defect and to achieve an optimal situation in the cervix, i.e., a sharp boundary between the two epithelia without any metaplastic events. Only then can we be confident that we are providing primary prevention.

The second case involves typical secondary prevention, i.e., elimination of already-existing precancerous states. Success involves complete healing, or at least alteration, of the defect to an oncologically negative one. This has been done with both the Dynatech instrument and the Erbo-Cryo-P instrument at the Gynecological Obstetrical Clinic of LFH KU in Prague.

Using the former of these devices, we treated 127 women, in whose cases oncological negativity was confirmed colposcopically and cytologically. Monitoring by both methods for an initial 3-month period confirmed that the procedure was unsuccessful in only 7 percent of the cases and successful in 93 percent. An optimal state was, however, achieved in only 47 percent of the cases.

The second of these instruments was used to treat 187 cases, in which the prebioptic finding was more or less suspect (colposcopy K_{2-3} or higher, cytological test III+ or higher). The expected histological basis accordingly ranged from a precancerous state to carcinoma in situ, while in some cases (only slightly suspect defects) a benign finding could be expected. The procedure was unsuccessful in 22 percent of the cases, while the results were good in the remaining 78 percent. Of value is the assurance that the presence of possible residual precancerous changes is not without signs and can be detected prebioptically in time.

In conclusion, we may make the following suggestions:

1. In benign defects, cryotherapy is the method of choice over DKG.

2. In suspect defects, cryotherapy is an improvement and accordingly highly desirable, particularly in the case of very young women. When the procedure is unsuccessful, i.e., when the focus is not entirely eliminated, conization is indicated.

Masek, J.: The use of Cryosurgery in the Treatment of Malignant Tumors

Arnold has already experimented with tissue destruction by freezing in 1852. However, his unquestionably good idea fell into oblivion primarily because of the unavailability of a means of cryodestruction. It is only in recent decades that there has been a renaissance of this method, primarily for the destruction of various types of tumors. Accordingly a number of cryodestruction systems of widely varying quality and effectiveness have come into existence throughout the world.

So far, there has not been much experience with this method in this country, because of the unavailability of suitable instruments. Foreign systems are extremely expensive and accordingly difficult to acquire, and devices produced in this country did not previously exist.

To effect necrosis of living tissue, including that of tumors, requires a tissue temperature of -20° to -25° C. A necessary precondition is an extremely rapid drop of the temperature in the tissue, resulting in slow thawing. Only in this way is it possible to assure necrosis of all cells and a sharp boundary between dead and living tissue. Currently these conditions can be fulfilled only by means of instruments which use for cooling either expansion of a gas (carbon dioxide or nitrous oxide), with which temperatures of -70° to -80° C can be attained, or evaporation of liquid nitrogen, which makes it possible to operate at temperatures down to -196° C.

The Surgical Clinic of the Faculty Hospital in Motol acquired its first experience with cryosurgery 2 years ago, when it was lent a Dynatech 8500 freezing system. This device works on the gas expansion principle using as a coolant nitrous oxide, which is available in all surgical departments. Although this is a great advantage of the device, its cooling power is very low. It can reach a minimum temperature of -80° C. The thickness of the frozen layer of tissue is only a few millimeters and the boundary between living and necrotized tissue is not sharp.

We used this device in more than 50 operations and found that it is highly useful, especially for small benign tumors such as condylomata accuminata, single hemorrhoidal foci and the like. However, destruction of malignant tumors requires a device with a much greater freezing power, i.e., a device which uses liquid nitrogen as a coolant and achieves tip temperatures of about -190° C very rapidly. A freezing system meeting these requirements was developed jointly by VUSE Bechovice, the Institute of Physics of CSAV and the Institute of Instrumental Engineering of CSAV.

This device has already passed through the clinical testing stage,

As part of the clinical testing, we conducted 23 operations at the surgical clinic in Motol using the device, in 18 cases for malignant tumors and in 5 for benign tumors. All tumors were so advanced that conventional surgical procedures were impossible. These tumors involved great distress: they all hemorrhaged repeatedly and were accompanied by severe pain, making it impossible for the patients to walk or sit. In all cases cryodestruction was followed by marked alleviation of the patients' distress. In some cases we observed a cessation of progressive cachexia, the appetite returned and the patients gained weight. This phenomenon is most probably explained in terms of the specific active immunication following cryosurgical procedures which has been described in the literature. This apparently involves immunization by antigens liberated from the tumor tissue during cryodestruction.

In conclusion, cryodestruction of tumors is only an auxiliary method, which cannot replace conventional surgical treatment. However, it is useful and has an excellent effect in cases where the extent of the process cannot be otherwise surgically affected, and hence as a palliative procedure, which, however, suitably improves the well-being of the patients, or in cases when a radical surgical procedure cannot be undertaken for other, e.g., internal, reasons.

Riha, J.: Cryotherapy of Benign Tumors

Between November 1978 and September 1980, some 91 cryodestruction procedures were conducted on benign tumors at the surgical, gynecological and opthalmological departments of the Benesov Hosptial. These were benign skin proctological tumors and benign lesions of the cervix. The number of cases is smaller than the number of malignant tumors treated because initially the indications for the process were very rigorously defined and were only expanded after the surgeons' experience increased.

Table 1. Number of Benign Tumors and Results Obtained

	Excellent	Very Good	Good
Hemorrhoids	14	2	
Skin	15	2	
Ectropium	43	10	1

Evaluations were made according to the following criteria: 1. excellent; local healing, with a complete cosmetic effect in the case of skin tumors; 2. very good: local healing, with slight scarring in skin tumors; 3. good: local healing associated with a prolonged recovery period and repeated destruction.

We did not include in this number a group of 21 basaliomas; following WHO, we include them among malignant skin tumors. After local destruction, in 19 cases there was an excellent curative effect and in 2 cases a very good healing of the pathological lesion.

The effects of low temperatures on living tissue can be very well traced during the cryodestruction of skin tumors and in subsequent healing. They are: an analgesic effect, a hemostatic effect, and destruction and necrosis of tissue in the treated area, associated with a demarcation effect, where the lesion produced is sharply demarcated from the surrounding tissue. Separation of the necrosis after cryodestruction in skin tumors begins after 4 days; depending on the location; the scabs produced should not be removed early because of the possibility of producing scarring. Healing after cryodestruction is very good in cosmetic terms, and hyperplastic, hyperkeloid scars are not produced. This is typical of healing after cryodestruction.

The pathologically altered tissues may be sampled for histological analysis before cryodestruction and during and immediately after the procedure; otherwise there would be changes in the microstructure of the bioptically examined material.

Cryodestruction is extremely beneficial in treating proctological disorders. These involve primarily a group of hemorrhoid disorders. It has been used in the treatment of second- and third-stage hemorrhoidal foci and acute hematomas in hemorrhoidal foci, and in reoccurrence of hemorrhoids after earlier surgical procedures. Cryodestruction methods are also used in treating anal fissures and perianal condylomata. In the postoperative stage, edema occurs after 2 days, gradually disappearing after 4 days. During this period there is also gradual separation of the necrotic tissue residua. The cryodestruction temperature did not fall below -80° C; microthermometers were used in all cases to monitor the temperature.

Evaluation of the results of treatment of benign gynecological lesions is in accordance with the results described in the other presentations.

In conclusion, it may be stated that cryodestruction is extremely beneficial in the treatment of benign lesions as a result of its simplicity for both the surgeon and the patient, and on account of the possibility of using it in outpatient treatment and at full load. The range of circumstances in which it is indicated is expanding rapidly as experience accumulates.

Hanek, P.: Use of Cryosurgery in the Orofacial Area

The treatment of tumors of the orofacial area has its own specific problems resulting from the location of the area. The proximity of vitally important organs and trunk nerves and blood vessels frequently rules out the required radical procedures even in the elimination of benign tumors. This question comes to the forefront particularly in operations on malignant tumors. Also of importance is the cosmetic problem. The patients react strongly to scars, sometimes to extremely inconspicuous ones, produced on the face as a result of the operation.

As a result, the First Stomatological Clinic of the Faculty of General Medicine of KU in Prague has closely followed the development of the new treatment method of cryosurgery, which has promised an improvement in this area, and has welcomed the introduction of this therapeutic approach into clinical practice.

Stomatologists' experience with cryosurgery has thus far been rather limited, but the results have been extremely satisfactory. Thus far, cryosurgery has been used to treat benign tumors whose clinical features were quite clear and convincing. Treatment of malignant tumors was begun only after sufficient experience with the method had been accumulated.

On the basis of clinical experience, the primary advantage of cryosurgery is considered to be the fact that it involves a rapid, painless, bloodless method which subjects the patient to little stress. Because of its painless nature, there is no need to use even local anesthesia. Accordingly it has given a good account of itself in the case of high-risk and allergic patients. The method makes it possible to destroy pathological tissue safely. The scarring resulting from the use of the cryocauter is very fine and cosmetically is surprisingly inconspicuous. The device is easy and safe to operate. The tips are easy to replace and to disinfect. The temperatures needed to destroy the tumor are precisely and simply displayed.

The long duration of healing is considered to be something of a disadvantage of the cryocauter as compared with classical surgical methods.

Experience indicates that cryocauter treatment is divided into several characteristic stages:

1. Directly after the operation the tissue is white, cold and hard. However, the tip of the cryocauter can be easily withdrawn from the tissue after about a minute.

2. Up to 5 hours after the operation there begins a stage characterized by intense edema.

3. During the next 12 to 24 hours blisters are formed, which rapidly use their integrity on the mucous membrane, while the bottom of the defect is covered with fibrin. The epithelial covering of the skin is preserved and the blistering gradually disappears.

4. The next stage, which arises in about 2 to 3 days, is characterized by the formation of necrosis and its subsequent demarcation.

5. After 3 to 4 weeks the necrosis on the mucous membrane separates; separation takes longer on the skin. Accompanying the separation of necrosis, new tissue is formed from the bottom of the defect, while epithelization gradually proceeds from the edges. The ultimate scarring is fine and inconspicuous and causes no functional difficulties.

In using this method, this stage must be kept in mind, because it is particularly the stage of necrosis and edema which is threatening in the orofacial area.

At the stomatological clinic, this method has thus far been used only to treat the following benign tumors: hemangioma cavernosum, hemangioma capillare, cornu cutaneum, verrucae vulgares and lymphangioma linguae.

Cryosurgery unquestionably expends therapeutic capabilities in the treatment of neoplasm in the oroficial area. After sufficient experience is acquired, an attempt will be made to apply this method to the treatment of malignant neoplasms in the orofacial area.

There was extensive discussion on the subject.

L. Kremlicka, M D of the Ophthalmological Clinic of IOF in Praha Na Bulovce Hospital stated:

We have been engaged in practical cryotherapy for almost 2 years within the framework of the agreement on cooperation between the Cryomedicine Department of the Dresden Medical Academy [LAD] and the Ophthalmological Department of the Institute for Further Education of Physicians and Pharmacists in Prague. We use devices developed and produced in East Germany and follow a procedure which has been tested over a long period at LAD.

In the treatment of malignant and benign tumors in the vicinity of the eye, on the eyelids and on the conjunctivae, we use a device containing liquid nitrogen based on either the principle of direct cooling, i.e., so-called "contact freezing," using a temperature of -168°to -180° C at the tip of the applicators, or a device which sprays liquid nitrogen directly on the surface of the tumor, i.e., so-called "spray freezing," with a temperature down to -196° C. For treatment of certain tumors on the cornea we have an applicator cooled with liquid nitrous oxide (N_2O) for brief use at working temperature of -70° C. All the devices which we use are based on the principle of evaporation of coolant in an open system, and the applicators lack feed hoses.

On the basis of opthalmological indications, cryotherapy is particularly suitable for use with tumors in the so-called "critical locations," such as the eyelid, the interior corner in the vicinity of the tear ducts, and other locations where plastic surgery following excision of tumors is particularly difficult, or where there would be a danger of subsequent complications (obliteration of tear ducts, ectropium, entropium of the edge of the eyelid, trichiasis and the like).

Thus far we have carried out more than 100 cryotherapeutical procedures (including treatment of 60 basaliomas). In the basalioma cases treated, there were to reoccurrences, in cases of extensive and deep-seated tumors which had been otherwise treated before our intervention, and which had already reappeared previously. However, we are aware that our observation times thus far are extremely short and that accordingly our results cannot yet be evaluated. In terms of the cosmetic consideration of preserving the function of the organ in question, cryotherapy can be recommended as a very mild method.

J . Capek, M D, Chief Physician of the Urological Department of the Thomeyer Hospital in Prague-Krc, stated:

In our urological department at Prague-Krc we tested an Erbokryo PSC device and have carried out cryodestruction of 15 adenomas and 3 carcinomas of the prostate. These were patients of advanced age; the oldest was 80 years old, and all had serious cardiopulmonary problems to such a degree that a normal operation was ruled out.

It is reported that about 3 percent of men suffering from obstruction of the urinary bladder cannot be operated on because of unfavorable internal conditions. After application of extremely low temperature of -180°C, we always use cauterization at +200° C after freezing, which has the advantage of not causing hemorrhage after the operation. We noted relatively pronounced bleeding in only two cases, in one case, the day after the operation and, in the other case, 6 days after it; a transfusion was given in the latter case. We conducted the procedure with intravenous application of Tramal. The patients stood up to the operation very well and all were sent home the next day. We removed the catheters up to 2 months after the operations.

Thirteen patients were able to urinate spontaneously with a residuum of less than 50 milliliters, and one patient was a residuum of 100 milliliters. Two were again catheterized.

Our introductory experience with cryodestruction of adenomas and carcinomas of the prostate indicates that this is an effective method enabling patients who otherwise would have been condemned to permanent catheterization to urinate freely. Thus cryocauterization of the prostate extends our range of urological procedures.

J. Tusoky, M D of the Railroad Polyclinic in Prague stated:

After therapeutic procedures the problem is objectivization of results. Methods of evaluating the epithelium of the cervix are not reliable. Bioptic examination is complicated. An excellent method of objectivization is microscopic examination in vivo using a Soviet-produced colpomicroscope which is being successfully used in the epublic oncological institute in Vil'nyus, Soviet Lithuania. Professor Vikshraytis f this institute has published a work, "Prizhiznennaya kolpomikroskopiya [In-Vivo lpomicroscopy]," which deals with the problem of objectivization in detail.

The Dermatological Clinic of the Faculty of General Medicine, Charles University in Prague, headed by Prof J. Stava, M D, will soon begin cryotherapy using a new device.

The extraordinarily interesting evening was also valuable owing to the fact that Docent J. Malek, Ph D, Candidate of Sciences, introduced a prototype of cryosurgical system that has recently been completed (14 days ago). This is the newest type of apparatus, and was constructed by the VUSE in Prague-Bechovice. The device is suited for extensive operations.

The evening's session, with its extremely high level of expertise and its highly instructive nature, was chaired by Prof Vladimir Cihak, M D, Dr of Sciences.

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CZECHOSLOVAKIA

INDIVIDUAL ENGINE OIL TESTS REDUCE OIL CONSUMPTION

Bratislave ROPA A UHLIE in Czech No 1, 13 Jan 81 pp 59-62

[Article by Eng I Pridal: "Experience in Conserving Fuels and Lubricants in CSAD Transport Plant No 707"]

[Text] In 1975 the CSAD [Czechoslovak Motor Transport] Ostrava developed and later put into practice a method for periodic determination of motor oil quality using rapid methods. The aim was maximum utilization of the operating capabilities of the motor oil so that periodic evaluation of motor oil quality became an effective way of using and economizing on these scarce materials.

The rapid methods for periodic determination of motor oil quality were worked out theoretically at the beginning of 1975 using the results of practical tests performed in 1973 and 1974 in the transport plant of CSAD Havirov.

Evaluation of Oil

The practical tests established that aging, i.e., degradation of motor oil, proceeds differently in each individual engine. Accordingly we must use the rapid methods to analyze the motor oil characteristics which indicate to what extent the oil is still capable of performing its function in the engine. In transportation work it is sufficient to determine the following characteristics of the oil:

a. carbonization residue found by the Conradson Carbonization Test (CCT);

b. dilution of the oil by fuel;

c. presence of water in the oil.

We chose rapid methods of approximate oil-quality determination because in the CSAD transport plants, i.e., in practically all transport organizations, it is necessary to determine quickly whether the oil is still performing its function in the engine or whether it has been degraded to such an extent that it must be changed. In addition to speed, however, feliability, simplicity and precision are also important. But in transport work we cannot demand high precision. The critical factor is speed, and accordingly we used the rapid method, which gives us the basis for the necessary decisions within 15 minutes.

Individual Rapid Methods

1. The CCT is carried out in an OGP instrument produced in East Germany. The apparatus is used to measure the amount of light which passes through a sample of oil diluted 1:9 with technical gasoline. The value is measured with a microammeter and the CCT result is found as a percentage from a table specially worked out for class A oils and one for class AD oils (all types).

2. Determination of the degree of dilution of the oil by fuel involves primarily determination of its viscosity. The time taken by the oil to flow out of a vessel with an orifice, the so-called "flow cup," is measured. This cup is produced for all CSAD plants by the national enterprise in Ostrava. The sample must be warmed to the temperature for which we have worked out the tables, most frequently 50° C; we also have tables for higher temperatures. The tables specify the flow time for oil diluted 5 percent with fuel. If the flow time for the sample in question is longer than the figure given in the table for the temperature in question, the viscosity value is passing. If the time is shorter, the oil must be changed.

Note: extensive fouling of the oil with carbon, i.e., a high CCT value, lengthens the flow time. A certain amount of experience is required for the attendant to judge the results correctly, particularly in the case of borderline values.

3. The presence of water in the oil is established by a simple method, i.e., by a modification of the test-tube foaming method. The oil to be tested is allowed to fall drop by drop on the sole plate of a flatiron which has been turned upside down and heated to 100-120° C. We determine the moisture content by foaming; the attendant determines the extent of foaming, and then the water content by table.

We do not determine any other characteristics during routine quality control. The above-mentioned characteristics are quite sufficient for a determination of whether the oil must be changed or can still be used in the engine. Since 1975, when we introduced this type of monitoring of motor oil, we have found no need to expand the analysis to include additional characteristics.

Experience With the Rapid Methods

To introduce these types of routine motor oil analysis in transport plants, the primary necessity is to acquaint the traffic personnel with the idea and system of analysis. In our plants, since the checking was instituted the drivers themselves have striven to get the analysis of the oil in their vehicles performed within the specified time periods.

The system of oil checking by the rapid method was developed for checking oil quality in vehicles with diesel engines. From the beginning, however, we also monitored oil from vehicles with spark-ignition engines. The reason was to maintain driver discipline and to monitor the liquid content of the oil in spark-ignition engines.

All vehicles must have cards showing the type of oil used. This is a self-evident precaution where the drivers are rotated for each vehicle and where several types of oil are used.

When the changeover was made from the previous approach of planned oil changes in accordance with the number of kilometers driven (or the number of engineer hours), to oil change on the basis of analytical determination of oil quality, our transport plant used the class AD oil mixture, or class A oil mixture in some vehicles. In addition we had some vehicles (Bucegi) with spark-ignition engines. By introducing this new method of oil checking during operation, we realized considerable savings, even in the first 3 months, compared with previous experience. This is clearly shown by Table 1. The savings shown are actual savings, i.e., losses have been subtracted. Thus we have been able to increase the oil-change interval for all of our vehicles on the basis of analytical results. However, in some vehicles it was necessary to shorten the oil-change interval considerably when the permissible tolerances for some of the parameters were exceeded.

Table 1.

Tabulka I

rok 1	ujeto motor. vozidly km 2	spotř. oleje na vým. l 3	4 úsp. oleje proti předch. plán. praxi		5 úspora oleje na 100 km	
			l	Kčs	l	Kčs
1976	24 111 178	48 236	12 649	86 785,10	0,052	0,360
1977	24 701 997	5[illegible] 100	17 390	129 142,—	0,070	0,523
1978	26 049 629	6[illegible] 100	17 610	134 277,40	0,068	0,515
1979	25 926 021	61 395	16 708	135 151,70	0,064	0,482
celk.	100 788 825	232 831	64 357	485 356,20	0,064	0,482

V tabulce se neuvažuje olej na dolévání. Jeho spotřeba je při obou způsobech (dříve a na základě analýzy) kontroly, stejná.

Key:

1. Year
2. Engine kilometers
3. Oil saving per change, liters
4. Oil saving compared with previous procedure
5. Oil saving per 100 kilometers

Note: The table does not include oil added between changes. The quantities used were the same in both methods (old method and oil change on basis of analysis).

The economic benefit from motor-oil quality assurance through rapid analysis should not be considered solely in terms of oil savings. Other savings are realized from conservation of time and manpower resulting from a consistently smaller number of oil changes. Timely identification of defects through the analyses, e.g., considerable dilution of the oil by fuel or the presence of water, indicates the possibility that an engine may develop trouble or break down, and accordingly we can prevent it. We do not overhaul the engine totally, but merely eliminate the problem that is found, so that we do not have to remove the engine from operation. Obviously such repairs are much smaller, which also magnifies the current spare parts problem.

When we introduced the new method of determining whether oil should be changed, some expressed the opinion that lengthening the mileage between oil changes would increase the number of engine problems and breakdowns. But there has never been a case of engine trouble resulting from degraded oil operating qualities. The causes of engine trouble or breakdowns have always come from another source, often the fault of the driver, i.e., his manner or technique of driving, so-called "winding up," which produces overheating and accordingly baking, driving without water and the like. In order to eliminate the risk of engine trouble or breakdowns, in some particularly difficult cases (the M 634 L SD 11 bus), we have been using M6 AD S II oil in some vehicles of the type for 2 years; M 8 AD Super Mogul oil has been used in two such vehicles. We found that the M6 AD S II oil can stand a greater temperature load, so that it is more resistant to baking. At the same time, we increased the interval between oil changes by 2,000 kilometers compared to M6 AD oil. We achieved excellent engine results with Super Mogul oil. The oil-change interval is at about the permissible limit, 19,000-20,000 kilometers. In addition to resistance to high temperatures, we also found a smaller consumption of oil added between changes. When one of these engines was disassembled we found less crankshaft bearing wear, and excellent overall engine condition.

In Roman type vehicles the motor oil was changed every 4,000-5,000 kilometers when using M6 AD oil. Accordingly we tried to use M6 AD S II oil. But tests showed that the oil-change interval could not be extended in vehicles of this type by using better oil. The analytical values of the charact⁻ristics we determined were practically the same, and accordingly we went back to using M6 AD oil.

We devoted particular attention to vehicles assigned to MKD [International Container Transport] transport. These are all vehicles with supercharged engines, so that they cannot be lubricated with M6 AD oil. It is not uncommon for these vehicles to return to the plant after running about 7,000 kilometers. Under the previous system the oil would be changed in such cases. Now, after the vehicle makes its trip we analyze it with the methods described, and in most cases we find that the oil does not need to be changed: it passes the test and has considerable life left. Accordingly, we may leave the oil in for another 7,000 kilometers without risk of damaging the engine. In practice this means that the vehicle could make, for example, two round trips to Portugal.

We also have a few Volvo F89 vehicles in the inventory. In the past we were uneasy about using our oils in these vehicles. Before we introduced our method of oil-quality control during operation, we changed the oil in these vehicles after every 7,000 or 8,000 kilometers. Since our method of rapid analysis was introduced, these vehicles have been running 500,000 to 650,000 kilometers without a general overhaul, and with an oil-change interval of 12,500 to 14,800 kilometers, adding 0.10 to 0.18 cubic decimeters per hundred kilometers to maintain the oil level. We have used Czechoslovak M6 AD S II oil from the start in these vehicles.

For comparison purposes, we show in Table 2 the oil-change intervals and the amounts of oil added between changes in several types of vehicles.

In checking motor-oil quality by rapid analysis we also found out that after general overhaul the oil must always be changed at shorter intervals, about one-third shorter. The reason is the large CCT value and frequently excessive oil dilution by fuel, particularly in T138, T148 and S706RT engines. We can only explain this in terms of poor-quality repair.

Table 2

Tabulka 2

1 typ vozidla 1	2 použitý olej 2	km motoru 3	4 interval vým. km	5 náklady na olej-vým. Kčs/100 km	6 spotř. na doliti l/100 km	7 celk. náklady (vym.+dol.) Kčs/100 km
Avia A 30	M 6 AD	40—100 tis.	8,5 tis.	0,93	0,2	2,51
	M 6 AD S II	35 tis. 8	10—13 tis. 8	0,79—0,61	0,15	1,98—1,80
	M 8 AD	18 tis.	12 tis. pokr.	1,13	0,1	2,48
IFA	M 6 AD S II	26 tis.	13 tis.	0,97	0,2	2,55
Roman	M 6 AD	140—180 tis.	5—10 tis.	1,26	0,2	2,84
	M 6 AD S II	120—140 tis.	6—9 tis.	1,28	0,2	2,86
Š 706 RT	M 6 A	100—120 tis.	8 tis.	1,48	0,25	3,03
RTO	M 6 AD	100—350 tis.	6—10 tis.	1,64	0,3	4,01
ŠL-11, ŠD-11	M 6 AD	330—550 tis.	13,5 tis.	1,29	0,25	3,27
Š 706 MTV MTC	M 6 AD S II	100—300 tis.	13,5—14 tis.	1,17—1,13	0,15	2,36—2,32
(M 634)	M 8 AD	140—200 tis.	20 tis.	1,42	0,12	3,04
Volvo F 89	M 6 AD S II	450—650 tis.	13,5 tis.	1,44	0,15	2,63

Key:

1. Type of vehicle
2. Type of oil used
3. Engine kilometers
4. Oil-change interval, kilometers
5. Expenditure on oil change, Kcs per 100 kilometers
6. Oil added between changes, liters per 100 kilometers
7. Total expenditure (oil change and oil added between changes), Kcs per 100 kilometers
8. thousand

Conclusion

After more than 4 years' experience with motor-oil checking by means of this type of analysis, we may state that the results achieved by the method are not accidental. This is a method which makes it possible to decrease considerably the consumption of motor oils: total oil consumption in our transport plant, for example, decreased by 20 percent. The total saving is affected substantially by the use of oil to maintain the oil level in the engine when it is in bad condition. When engines were in good operating condition the savings were much greater, i.e., up to 50 percent on oil added between changes. It may be assumed that this would result in an additional 15 to 20 percent saving on oil. There is not only an economic result within the plant and enterprise, but also an important societywide example. By introducing our method of checking the quality of oil during operation, all of society could make a contribution in an area which is beginning to be a worldwide problem.

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CZECHOSLOVAKIA

SLOWER GROWTH, BETTER QUALITY TARGETED IN CSSR METALLURGY

Prague HUTNICKE LISTY in Czech No 2, Feb 81 pp 148-149

[Article: "Third National Metallurgical Industry Aktiv in Kladno"]

[Text] In connection with the eighth CPCZ Central Committee session, and with the 15th anniversary of its own activity, VHJ Hutnictvi Zeleza [VHJ HZ] held its third National Metallurgical Industry Aktiv on 13-14 November 1980 in Kladno.

The purpose of the aktiv was to discuss the main tasks of VHJ HZ at the beginning of the Seventh Five-Year Plan; it was organized as a major production conference. Shortly after the 18th CPCZ Central Committee session, the top management of VHJ HZ supplemented its conclusions by evaluating implementation of the conclusions of the 15th CPCZ Congress and fulfillment of the tasks included in the Sixth Five-Year Plan, while simultaneously discussing problems and tasks of VHZ HZ in the Seventh Five-Year Plan and ways of dealing with them.

The next week, an aktiv of the leading trade unions officials of ROH [Revolutionary Trade Union Movement] organizations and bodies followed the discussions of the national metallurgical workers aktiv. It fulfilled one of the main tasks of ROH during the period of preparation for the 16th CPCZ Congress which had been assigned by the 10th ROH plenary session, and established the main directions and the common approach of the economic leadership and the trade union organizations in further guiding the development of labor initiatives. The aim is to support to the maximum degree the preparations for the 16th CPCZ Congress. Metallurgical workers everywhere desire to live up to their tradition of fulfilling their assigned tasks in all respects.

One of the main aims of this aktiv was to map out the main guidelines for the Seventh Five-Year Plan, when limitations on raw materials and investment will restrict the scope of further activity. Within these limits, VHJ HZ will focus on the qualitative aspect of production and on these areas:

--assistance to the electrical engineering and electronics industries as sectors of great national economic importance, by supplying the needed special steels, particularly sheet metal;

--service to other sectors, especially to the chemical and foods industries and to machine building in general. This involves a more extensive range of products which admittedly are provided in small amounts, but which have high-level technical specifications. Solution of these problems will not be easy, and we have taken note of the fact that a single five-year plan will not be enough to satisfy the consumers' needs fully;

--conservation of metal, fuel and energy. This involves fulfillment of state goal-directed programs in this area, where it is true we achieved excellent progress in the last five-year plan; the exhaustion of reserves and the impossibility of carrying out the summary investment plans will mean a decrease in the percentage of conservation in this area;

--a concern for the status of the industrial technological base. We must be aware that we will be working with essentially the same production facilities as before, since the effects of capital construction will make themselves felt in this sector at the end of the Seventh Five-Year Plan or perhaps at the beginning of the Eighth. The Seventh Five-Year Plan will be extremely demanding as regards repairs, particularly of blast furnaces; the scheduled large number of blast-furnace repairs associated with modernization projects will create major challenges in supply and financing. We can no longer operate with stretched-out repair cycles, since they result in production difficulties. In the repair area, we will require help from the supplier organizations, both in construction work and in deliveries of processes and spare parts. An important problem in this context will be that of securing sufficient quantities of high-quality refractory materials;

--given the limitations on raw material inputs, the economy, and to a considerable degree production as well, will be dependent on our ability to utilize these raw materials. We must lay the groundwork for our activity by striving for maximum utility value from minimum inputs. In increasing utility value, we must base ourselves on the needs of the consumers, thereby helping them to decrease their materials consumption;

--we have a scientific research base which is well provided with both equipment and personnel. We will need to "rearm" this base, i.e., to orient it more resolutely toward the qualitative aspect of the production process, toward conservation of metal, fuels and energy, and toward expansion of the product selection in accordance with our consumers' needs. It will be necessary to hold an aktiv for the workers in the scientific research base this year to serve as a point of departure for this rearmament;

--a particularly demanding area will be the economic aspect of our activity, especially as a consequence of the introduction of the Set of Measures and the accompanying need for all our workers to become oriented toward new, substantially more demanding conditions. In particular, attention must be devoted to changes in management within the enterprise, and to khozraschet.

The changes in external conditions, and to some extend in internal ones, which affect the development of ferrous metallurgy are not of a temporary nature; we must expect them to persist.

It is evident that a continuation of the previous trend of steady growth in the production and consumption of steel is out of the question for the Czechoslovak economy. We must plan on consistently lower increases in metallurgical output; this is a basic change from the previous developmental trend.

For a number of years, we have been one of the countries with the largest per capita outputs of steel. We are first in per capita steel consumption. In spite of partial successes, particularly in recent years, we have not succeeded in catching up with the industrially advanced countries in per-unit [specifically] steel consumption. A comparison shows that our consumption is about 30 percent higher.

Thus our turn to conservation of steel is in accordance with the worldwide trend. The need to decrease metal consumption was discussed at the 18th CPCZ Central Committee session. We must subordinate to this high-priority consideration all of our contemplated reconstruction of the metallurgical base and in addition the further development of the Czechoslovak metallurgical industry, which affects the national economy in a number of areas.

However, the limitations on the growth of output do not mean that the development of the metallurgical industry will be stifled. On the contrary, the limitations on steel consumption will result in new, quality-oriented demands on metals production which it will be possible to meet primarily by significantly improving the quality of the metallurgical enterprises' production base. Innovation in production programs and improvement of the quality of metallurgical products is one precondition for decreasing steel consumption.

These plans and consequences can be summarized in the following main tasks:

--achieving a major expansion of thrift in the consumption of steel. This requirement affects the entire national economy, but especially the main consumers, i.e., the machine building, electrical engineering and construction sectors.

In order to achieve this goal, the metallurgical industry must create the preconditions for metal conservation by increasing the utility characteristics and quality of its products and by improving its selection and the promptness of its deliveries;

--mobilizing domestic sources of metal. This involves hitherto inadequately used secondary sources of metal such as slag, electric power station flyash and the like. The amount of usable scrap metal could be greatly increased by eliminating obsolete capital assets. The fact that insufficient use is made of this possibility is attested to by the country's long machinery life span, which is now 26 years and is steadily increasing. In the economically advanced countries the figure ranges from 15 to 18 years. Recently government decree No 282/1980 was adopted in order to mobilize metals sources.

--increasing the efficiency of utilization of metal directly in the metallurgical production cycle as well by introducing progressive manufacturing processes, which will produce savings of metal and also of fuels and of energy. It will be necessary to proceed more rapidly with modernization and concentration of the production base;

--increasing demands as regards the degree of cooperation and specialization within CEMA.

There is considerable untapped potential in all of these main areas. The plans for development of the individual sectors should also take account of these new circumstances, not only in planning and designing new machines and production innovations, but also in considering possibilities for structural change.

It will be possible to achieve a limited growth in domestic production only by decreasing the export of metal products, primarily to nonsocialist countries. What is entailed is a decrease in value terms, and it will be necessary to compensate the decrease in exports, at least partially, by improving the breakdown of materials exported.

An energetic turn toward quality and conservation of metal has become an important need throughout the society and one of the decisive preconditions for further successful development of the Czechoslovak economy. This is a comprehensive national economic problem which must be solved not only in metallurgy but in several other sectors of the Czechoslovak national economy as well.

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END